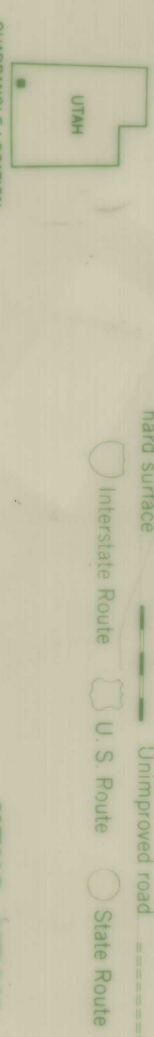
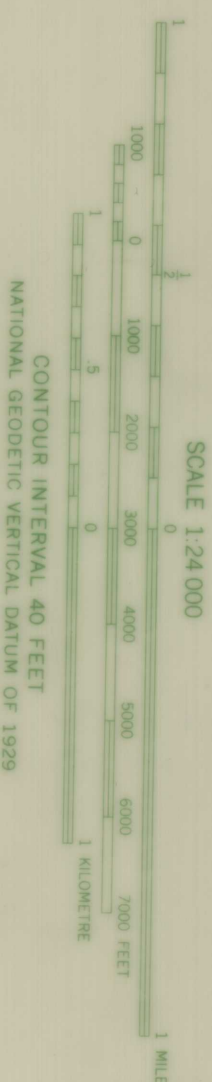
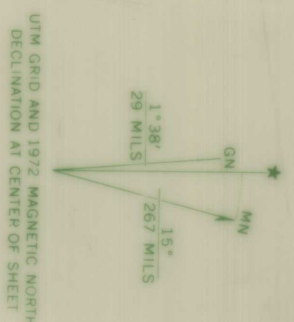


Control by USGS, NOS/NOAA, and U. S. Forest Service
Topography by photogrammetric methods from aerial
photographs taken 1972. Field checked 1972
Projection and 10 000 foot grid ticks (Utah
coordinate system, south zone (Lambert conformal conic)
1000-metre Universal Transverse Mercator grid ticks,
zone 12, shown in blue. 1927 North American datum
Fine red dashed lines indicate selected fence lines



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Interim Geologic Map of the Veyo Quadrangle,
Washington County, Utah

By

Janice M. Higgins

OPEN-FILE REPORT 401
UTAH GEOLOGICAL SURVEY
October 2002

VEYO, UTAH
N3715-W11337.5/7.5
1972

AMS 3228 1 SW-SERIES 1987

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a division of

UTAH DEPARTMENT OF NATURAL RESOURCES

in cooperation with

U.S. Geological Survey

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Description of Map Units

QUATERNARY

Alluvial deposits

Qal **Stream deposits** – Moderately to well-sorted clay to gravel deposits in large active drainages. Includes terraces up to 10 feet (3 m) above active channels and is 0 to 10 feet (0-3 m) thick.

Qat₂₋₃ **Stream-terrace deposits** – Well-rounded, pebble- to cobble-size clasts in a muddy to coarse sand matrix; includes deposits adjacent to and dissected by Qal. Qat2 is 10 to 30 feet (3-9 m) above active channels and is 0 to 20 feet (0-6 m) thick. Qat3 is 30 to 90 feet (9-27 m) above active channels and is typically 0 to 40 feet (0-12 m) thick.

Qag **Alluvial gravel** – Well-rounded, pebble- to cobble-size clasts in a muddy to coarse sand matrix; underlies lava flows in many areas, but only mapped where a gravel pit operation removed the overlying Magotsu Creek flow in the NE1/4 section 11, T. 40 S., R. 17 W.; 0 to 40 feet (0-12 m) thick.

Artificial deposits

Qf **Artificial-fill deposits** – Engineered fill and general borrow material used to create small dams and road foundations; thickness variable.

Eolian deposits

Qes **Eolian-sand deposits** – Well- to very well-sorted, very fine- to medium-grained, well-rounded, usually frosted, mostly quartz sand; derived primarily from the Navajo and Iron Springs Formations; commonly deposited in irregular hummocky mounds on the lee side of ridges; locally forms poorly developed dunes; 0 to 50 feet (0-15 m) thick.

Mass-movement deposits

Qmt **Talus deposits** – Very poorly sorted, angular boulders with minor fine-grained interstitial materials; deposited on and at the base of steep slopes; 0 to 20 feet (0-6 m) thick.

Qms **Landslide deposits** – Very poorly sorted clay- to boulder-size, locally derived debris in chaotic, hummocky mounds; located on steep slopes along the Santa Clara River drainage beneath basalt flows, with basal slip surfaces in the Co-op Creek Limestone Member of the Carmel Formation; thickness highly variable.

Mixed-Environment deposits

Qae **Mixed alluvial and eolian deposits** – Moderately to well-sorted, clay- to sand-sized alluvial sediment that locally includes abundant eolian sand and minor alluvial gravel; minor pedogenic carbonate development; mapped in broad valleys such as Diamond Valley, Santa Clara River valley, and southeast of Veyo Volcano; 0 to 30 feet (0-9 m) thick.

Qac, Qaco

Mixed alluvial and colluvial deposits – Poorly to moderately sorted clay- to boulder-size sediment in minor drainages; gradational with colluvial deposits; Qac deposits are in active drainages and Qaco deposits are dissected by active drainages; includes minor terraces too small to map separately; 0 to 10 feet (0-3 m) thick.

Qea **Mixed eolian and alluvial deposits** - Composed mostly of well-sorted eolian sand locally reworked by alluvial processes; includes minor alluvial deposits; mapped only in the southeast corner of the Veyo quadrangle, near more extensive deposits in the Santa Clara and Washington quadrangles; 0 to 20 feet (0-6 m) thick.

Qmtc **Mixed talus and colluvial deposits** - Conglomerate clasts and sand derived mostly from weathered QTa pediment deposits; deposited on and at the base of slopes eroded into the Muddy Creek and Iron Springs Formations in the northwest corner of the quadrangle; 0 to 10 feet (0-3 m) thick.

Basaltic flows and cinder cones

Divided into 14 flows based on field and geochemical relationships; $^{40}\text{Ar}/^{39}\text{Ar}$ ages are pending, and no geochemical data are available for several of the flows; thirteen of the flows converge in the Santa Clara River valley to create a complex sequence of flows that show varying degrees of incision; classified using the total alkali vs. silica diagram of LeBas and others (1986).

Qbu **Basaltic flows, undifferentiated** – Used as a map unit for isolated basalt exposures that have not been correlated to adjacent flows.

Qbs, Qbsc

Santa Clara flow and cinder cone – Dark-brownish-black to black subalkaline basalt flow (Qbs) and cinder cone (Qbsc); contains abundant small olivine phenocrysts in an aphanitic groundmass; flows have a very jagged aa surface, and an iridescent sheen is still present on protected surfaces, especially near the cinder cone; cinder cone has a youthful, symmetrical appearance and is partly quarried for cinders; estimated 10,000 to 20,000 years old; flow is typically 0 to 20 feet (0-6 m) thick.

Qbde, Qbdec

Dammeron Valley east flow and cinder cone – Dark-gray trachybasalt flow (Qbde) and cinder cone (Qbdec); contains small olivine phenocrysts in an aphanitic groundmass; cinder cone exhibits only minor rill erosion; flow is 0 to 20 feet (0-6 m) thick, but thickens dramatically near the cinder cone.

Qbrb **River bottom flow** – Dark-gray basaltic trachyandesite; contains some plagioclase phenocrysts and comparatively few olivine phenocrysts compared to nearby flows; preserved as several isolated remnants along the bottom of the Santa Clara

River drainage at the north edge of the map; source is unknown; 0 to 10 feet (0-3 m) thick.

Qbbd **Baker Dam flow** – Dark-gray, dense basalt with abundant olivine phenocrysts; present along the Santa Clara River northeast of Veyo; source is unknown; 0 to 20 feet (0-6 m) thick

Qbpr, Qbprc

Power Plant road flow and cinder cone – Dark-gray basaltic trachyandesite flow (Qbpr) and cinder cone (Qbprc); contains abundant small olivine phenocrysts in an aphanitic groundmass; exposed along the Santa Clara River in the northcentral part of the quadrangle; extensively quarried cinder cone has nearly been removed; flow is 0 to 50 feet (0-15 m) thick.

Qbsr **Subdivision ridge flow** – Dark-gray, fine-grained olivine basalt exposed west of the Santa Clara River at a higher elevation than the Baker Dam flow; source is unknown; 0 to 20 feet (0-6 m) thick.

Qbv₁₋₅, Qbvc

Veyo flows and cinder cone – Dark-gray, fine-grained basaltic trachyandesite flows (Qbv₁₋₅) and cinder cone (Qbvc); contains abundant olivine and sparse plagioclase phenocrysts; flow units are adapted from Embree (1969), with the Qbv₁ flow oldest and Qbv₅ youngest; large, well-preserved cinder cone has only moderately developed rill erosion; flows are 0 to 50 feet (0-15 m) thick, but may thicken dramatically near the cinder cone.

Qbmc, Qbmcc

Magotsu Creek flow and cinder cone – Medium- to dark-gray trachybasalt to basaltic trachyandesite flow (Qbmc) and cinder cone (Qbmcc); coarser grained with fewer olivine phenocrysts than most flows in the quadrangle; contains few plagioclase and rare quartz phenocrysts; cinder cone has been quarried from several pits; flow is 0 to 50 feet (0-15 m) thick.

Qbah **Aqueduct Hill flow** – Dark-gray, dense basaltic trachyandesite; contains small olivine phenocrysts and distinctive aggregates of plagioclase; may have erupted from hill 5082 in section 32, T. 39 S., R. 16 W.; 0 to 50 feet (0-15 m) thick.

Qbsm **Saddle Mountain flow** – Dark-gray, fine-grained basalt to basaltic trachyandesite; contains small olivine and plagioclase phenocrysts; erupted from a source about 1.5 miles (2.5 km) to the east; 0 to 50 feet (0-15 m) thick.

Qbc **Central flow** – Dark-gray, fine-grained olivine basalt with common, small plagioclase and rare quartz phenocrysts; preserved above the subdivision ridge flow in the northeast corner of the quadrangle; source is unknown; 0 to 50 feet (0-15 m) thick.

Qbcw **Central West flow** – Medium-gray, very coarse grained borderline trachyandesite to andesite, dacite, and trachydacite; characterized by large plagioclase phenocrysts; forms hilly, rugged topography and thus varies in thickness; generally 0 to 100 feet (0-30 m) thick; source is unknown.

Qbgw **Granite Wash flow** – Dark-gray, fine-grained basalt to trachybasalt with small olivine phenocrysts; scattered cinder deposits suggest that this flow may have erupted from hill 5672 in the northeast corner of the quadrangle; 0 to 100 feet (0-30 m) thick

Qbdn **Dammeron Valley north flow** – Dark-gray, dense basaltic trachyandesite to trachybasalt; contains common, small olivine and few plagioclase phenocrysts; source unknown; 0 to 50 feet (0-15 m) thick.

QUATERNARY/TERTIARY

Alluvial deposits

QTa **Alluvium** – Erosionally dissected alluvial deposits of silt, sand, gravel, and boulders; mostly coarse to very coarse, medium-gray, well-rounded boulder conglomerate derived from the Bull Valley and Beaver Dam Mountains; forms extensive, caliche-capped pediment surface that slopes southeast to Moody Wash and Magotsu Creek; unconformably overlies Muddy Creek and Iron Springs Formations; thickness varies, up to 150 feet (46 m).

TERTIARY

Muddy Creek Formation

Tm Light-tan to buff, indistinctly bedded, poorly consolidated pebbly sandstone, coarse sandstone, and sparse silty sandstone interbedded with sparse gravel and boulder conglomerate and light-gray to white tuff beds generally less than 3 feet (1 m) thick; basal strata are commonly faulted and slightly tilted to the northwest; thickness varies, up to 300 feet (90 m).

CRETACEOUS

Iron Springs Formation

Ki Interbedded, ledge-forming, mildly calcareous, cross-bedded, fine- to medium-grained sandstone and less resistant, poorly exposed sandstone, siltstone, and mudstone. The formation is variously colored grayish orange, pale yellowish orange, dark yellowish orange, white, and pale reddish brown, and is commonly heavily stained by iron-manganese oxides; liesegang banding is common; deposited in braided-stream and floodplain environments; palynology indicates a Cenomanian through Turonian age for strata near Gunlock (Hintze and others, 1994); 3,500 feet (1,065 m) thick.

Cedar Mountain Formation

Kcm Basal conglomerate clasts as big as 5 inches (15 cm) in diameter and composed mostly of quartzite and chert are well rounded; sandy matrix is orangish gray but weathers dark brownish black; commonly forms caprock and dipslope of cuestas; upper

bentonite bed is poorly exposed in southeast corner of the quadrangle and weathers to form a moderate-red “popcorn” soil; 0 to 100 feet (0-30 m) thick.

JURASSIC

Carmel Formation

Jcx **Crystal Creek Member** – Slope-forming, interbedded, generally thin-bedded, pale- to moderate-reddish-brown mudstone, siltstone, very fine-grained sandstone, and gypsum; poorly exposed in the southeast corner of the quadrangle; thickens eastward in adjoining quadrangles and is only locally preserved beneath the K-1 unconformity; 0 to 20 feet (0-6 m) thick.

Jccu **Upper Co-op Creek Limestone Member** – Thin interbeds of mudstone, siltstone, and limestone, with some very fine- to fine-grained sandstone; weathers to distinctly darker yellowish-brown hues than lower part of member; forms steep ledgy slopes; abundantly fossiliferous with *Pentacrinus* sp. columnals, bivalves, mollusks, and local oyster coquina; thickness varies from 120 to 190 feet (37-58 m).

Jccl **Lower Co-op Creek Limestone Member** – Laterally variable sequence of interbedded, generally thin-bedded, mudstone, siltstone, limestone, gypsum, and very fine- to fine-grained sandstone; weathers to a pale yellowish gray; forms steep ledgy slopes; abundantly fossiliferous with *Pentacrinus* sp. columnals, bivalves, mollusks; 220 feet (67 m) thick.

Temple Cap Formation

Jts **Sinawava Member** – Interbedded, moderate-reddish-brown mudstone, siltstone, very fine-grained silty sandstone, and lesser bedded and nodular gypsum; very poorly exposed, but forms red and gray slope that weathers to soft, gypsiferous soil; contains numerous thin greenish-gray mudstone (altered volcanic ash) beds; 360 feet (110 m) thick.

Navajo Sandstone








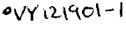

Jn Pale to moderate-reddish-brown, cross-bedded, poorly to moderately well-cemented, well-rounded, fine- to medium-grained, frosted quartz sandstone; strongly jointed; forms cliff; about 2,500 feet (760 m) thick, but only upper 1,800 feet (550 m) exposed in the quadrangle.

REFERENCES

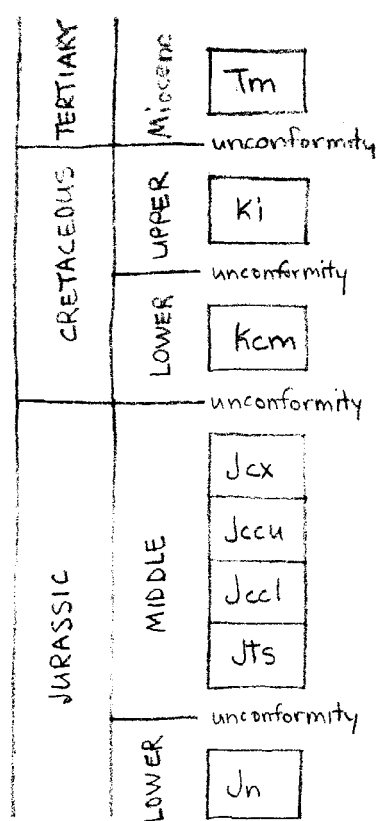
Embree, G.F., 1969, Lateral and vertical variations in a Quaternary basalt flow – petrography and chemistry of the Gunlock flow, southwestern Utah: Provo, Utah, Brigham Young University Geology Studies, v. 17, part 1, p. 67-115.

Hintze, L.F., Anderson, R.E., and Embree, G.F., 1994, Geologic map of the Motoqua and Gunlock quadrangles, Washington County, Utah: U.S. Geological Survey Miscellaneous Investigations Series Map I-2427, 7 p., scale 1:24,000.

Map Symbols

	Contact, dashed where approximately located
	Normal fault, dashed where approximately located, dotted where concealed, bar and ball on down-dropped side
	Major joint
	Strike and dip of inclined bedding
	Pit, g = sand and gravel, c = cinders
	Cinder cone
	Strike of near-vertical joint
	Sample location and number
	Spring

CORRELATION OF BEDROCK UNITS



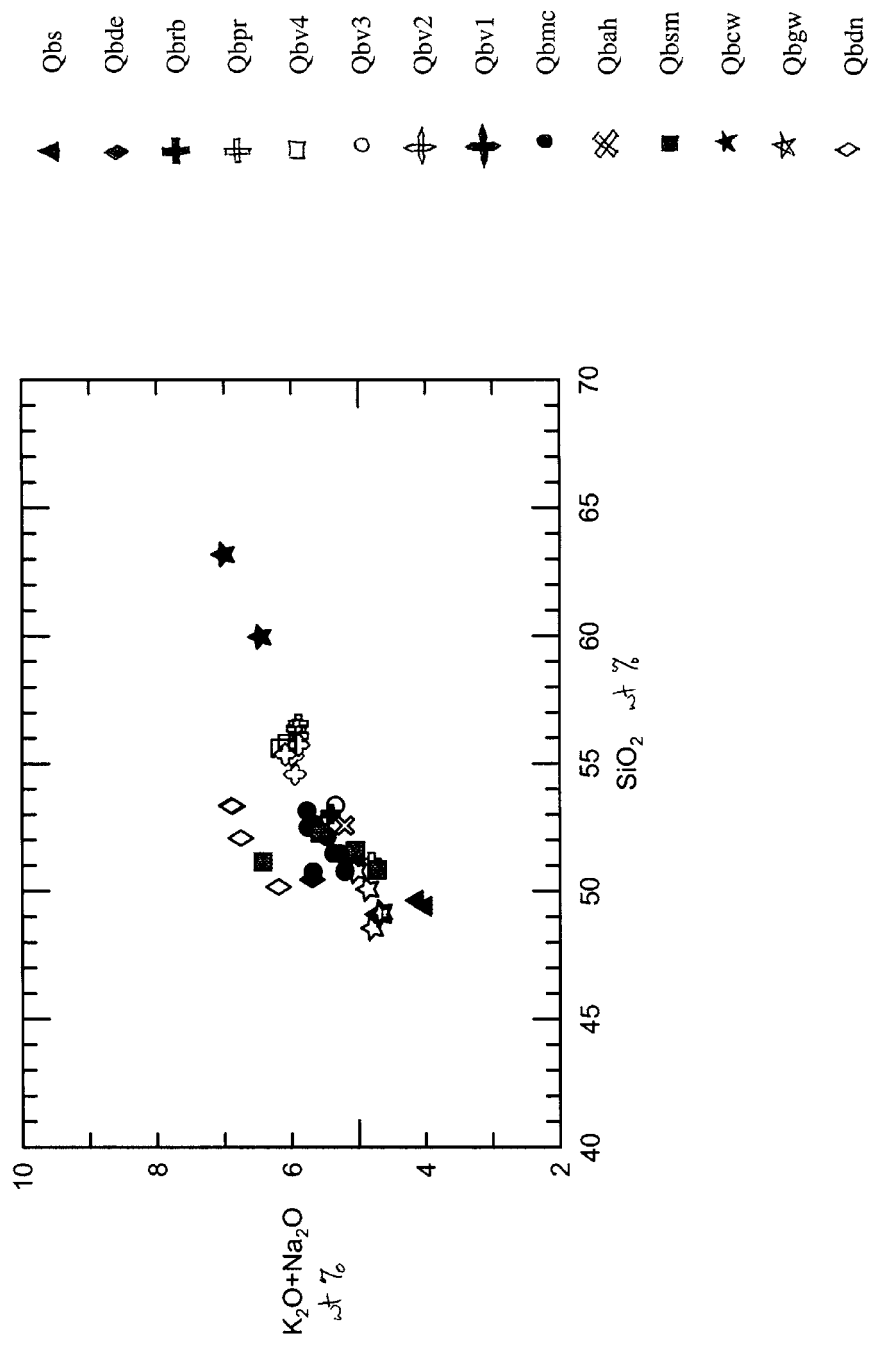
Veyo Quadrangle

J.M. Higgins

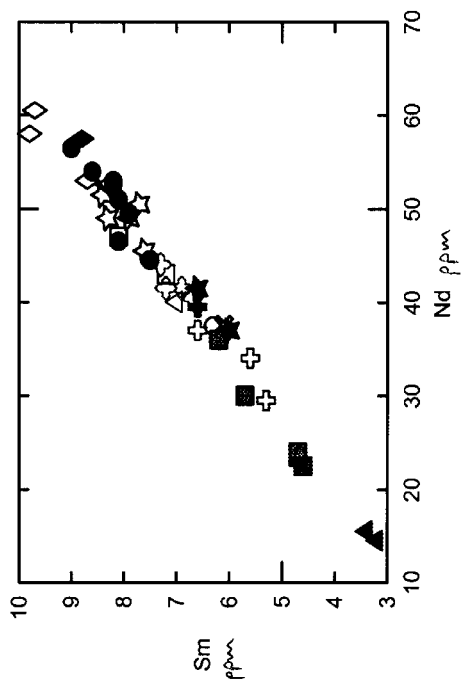
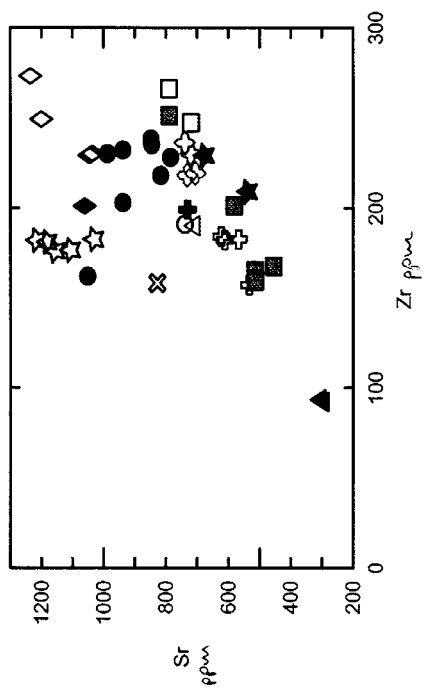
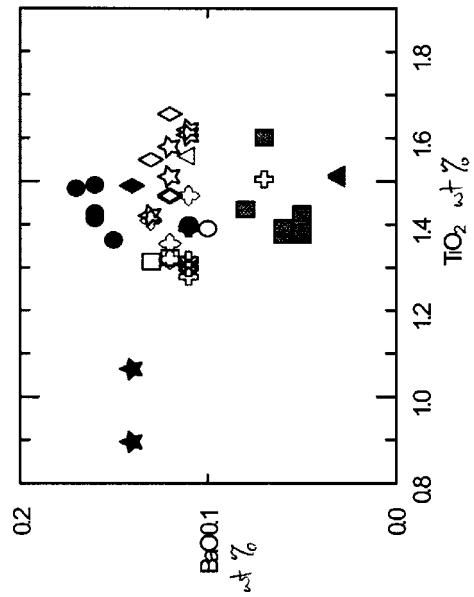
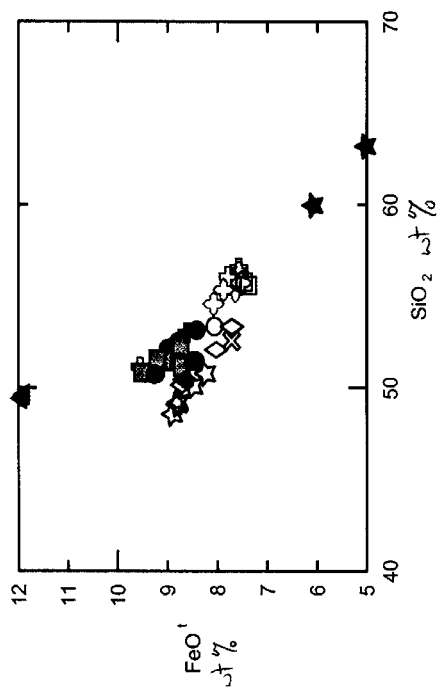
Veyo - J.M. Higgins

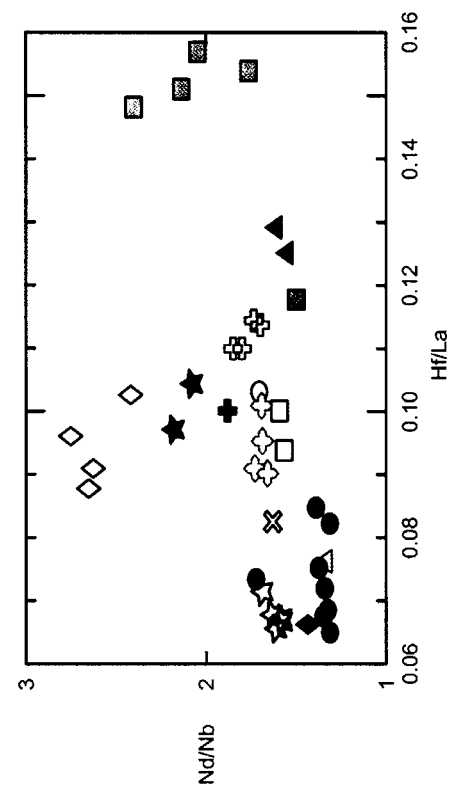
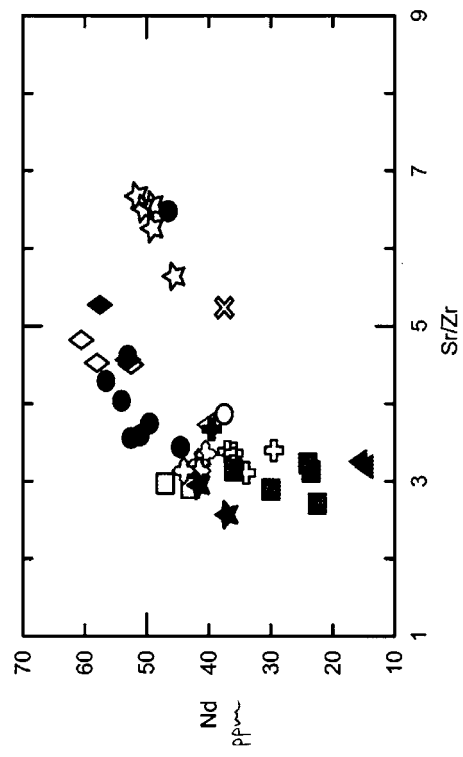
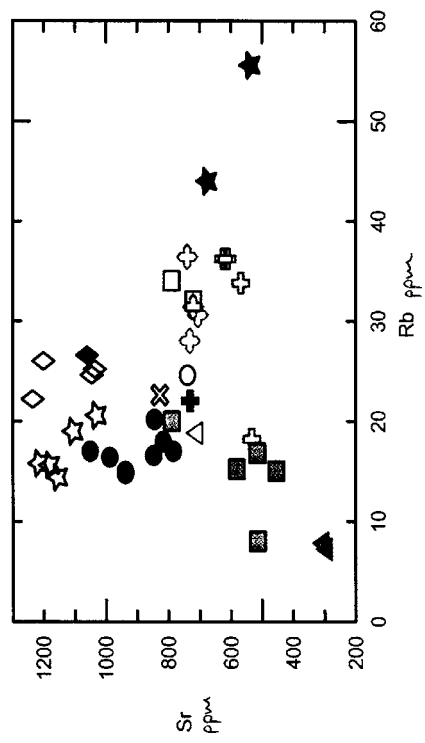
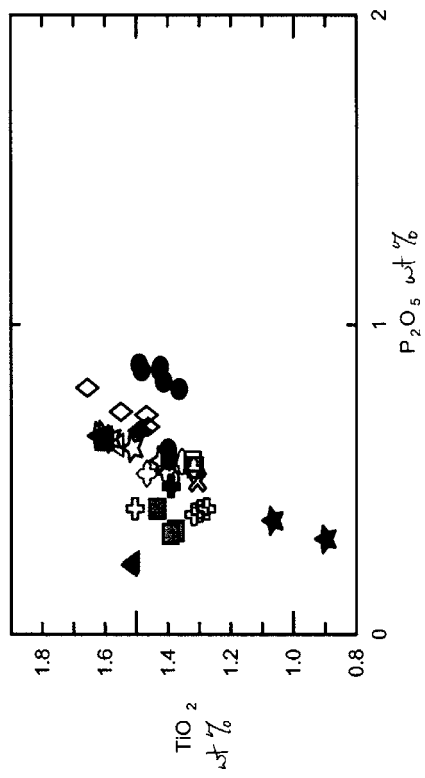
SYSTEM & SERIES		FORMATION	MEMBER	SYMBOL	THICKNESS feet (meters)	LITHOLOGY	
Quat. Pleist. Plio. Tertiary Miocene		Surficial deposits		Q	0-200-6		
		basalt flows		QB	0-100(0-30)		
		Alluvial gravel		Qta	150' (46)		
		Muddy Creek Formation		Tm	300' (91)		
Cretaceous upper		Iron Springs Formation		Ki	3500' (1065)		
	lower	Cedar Mountain Formation		Kcm	0-100' (0-30)		
	middle	Carmel Formation	Crystal Creek Mbr	Jcx	0-20' (0-6)		red jasper, mollusk <i>caquina</i> <i>pentacrinus</i> sp. gypsum
			Co-op Cr. ls. Mbr upper unit	Jccu	120-190' (37-58)		
		Temple Cap Formation	Co-op Cr. ls. Mbr lower unit	Jccl	220' (67)		
			Sinawava Member	Jts	360' (110)		
lower	Navajo Sandstone		Jn	1800'+ (550+)	high angle crossbeds		

Total Alkali vs. Silica and Variation Diagrams
for Basaltic Flows of the Veyo Quadrangle



See Description of Map Units for abbreviations.





Collector	Longitude	Latitude	Flow	7.5' Quadrangle	Sample No.	Collected	Jcode	Kcode	Lcode	Al2O3	BaO	CaO	Cr2O3	Fe2O3	K2O	MgO	MnO	Na2O
Higgins and Willis	113.625	37.258	Obs	Saddle Mountain	SM2202	8/3/2001	3	2		15.01	0.03	8.46	0.03	13	0.63		0.2	3.43
Higgins and Blek	113.744	37.279	Obsv1	Veyo	VY11702-2	1/17/2002	3	18		17.06	0.13	6.67	0.01	8.58	1.97	4.32	0.12	4
Higgins and Blek	113.724	37.316	Obsv1	Veyo	VY11702-3	1/17/2002	3	8		16.45	0.16	8.02	0.02	10.15	1.33	6.86	0.17	4.27
Higgins and Blek	113.722	37.314	Obsv2	Veyo	VY11702-4	1/17/2002	3	17		16.91	0.11	7.18	0.01	8.82	1.86	4.68	0.13	3.98
Higgins and Blek	113.701	37.359	Obsv1	Veyo	VY11702-5	1/17/2002	3	8		16.3	0.11	8.09	0.04	9.34	1.45	7.88	0.15	3.77
Higgins and Blek	113.698	37.358	Obsv1	Veyo	VY11702-6	1/17/2002	3	8		16.35	0.11	8.06	0.04	9.24	1.46	7.71	0.15	3.84
Higgins and Blek	113.650	37.372	Obsv2	Veyo	VY11702-7	1/17/2002	3	14		16.95	0.11	7.65	0.02	9.44	1.66	5.9	0.14	3.68
Higgins and Blek	113.650	37.372	Obsv2	Veyo	VY11702-8	1/17/2002	3	11		16.41	0.13	9.77	0.03	8.95	1.39	6.9	0.13	3.54
Higgins and Blek	113.680	37.325	Obsv1	Veyo	VY11702-9	1/17/2002	3	5		15.87	0.13	7.33	0.03	8.81	2.24	7.18	0.1	4.43
Higgins and Blek	113.631	37.367	Obsv1	Veyo	VY11802-1	1/18/2002	3	11		17.3	0.11	10.51	0.01	9.71	1.18	6.91	0.13	3.52
Higgins and Blek	113.635	37.368	Obsv1	Veyo	VY11802-3	1/18/2002	3	11		16.72	0.12	10.01	0.01	9.24	1.3	6.9	0.13	3.46
Higgins and Blek	113.642	37.368	Obsv1	Veyo	VY11802-4	1/18/2002	3	11		17.02	0.11	10.36	0.01	9.56	1.23	6.88	0.13	3.33
Higgins and Blek	113.643	37.368	Obsv1	Veyo	VY11802-5	1/18/2002	3	11		17.25	0.12	10.31	0.02	9.57	1.22	6.81	0.13	3.35
Higgins and Blek	113.645	37.368	Obsv1	Veyo	VY11802-6	1/18/2002	3	11		16.9	0.11	10.13	0.03	9.54	1.26	7.38	0.13	3.39
Higgins and Blek	113.672	37.371	Obsv1	Veyo	VY11802-7	1/18/2002	3	12		16.16	0.14	5.82	0.01	6.6	2.71	3.37	0.11	3.6
Higgins and Blek	113.722	37.287	Obsv3	Veyo	VY121901-1	12/19/2001	3	7		16.64	0.1	6.7	0.01	8.7	1.6	4.99	0.13	3.59
Higgins and Blek	113.743	37.286	Obsv2	Veyo	VY121901-2	12/19/2001	3	17		16.38	0.12	7.3	0.01	8.21	2	4.42	0.13	3.78
Higgins and Blek	113.744	37.282	Obsv1	Veyo	VY121901-3	12/19/2001	3	18		16.91	0.12	6.87	0.01	8.19	2.03	4.51	0.12	3.74
Higgins and Blek	113.748	37.290	Obsv1	Veyo	VY121901-4	12/19/2001	3	8		16.69	0.16	7.67	0.03	9.84	1.37	6.05	0.16	4.01
Higgins and Blek	113.761	37.281	Obsv1	Gunlock	VY121901-5	12/19/2001	3	8		16.96	0.16	7.48	0.02	9.61	1.49	5.92	0.15	4.11
Higgins and Blek	113.720	37.325	Obsv1	Veyo	VY121901-6	12/19/2001	3	8		16.68	0.17	7.49	0.02	9.62	1.48	5.81	0.16	4.18
Higgins and Blek	113.683	37.319	Obsv4	Veyo	VY121901-7	12/19/2001	3	3		16.89	0.13	6.64	0.01	8.16	2.05	4.69	0.12	3.91
Higgins and Blek	113.630	37.252	Obs	Veyo	VY122001-1	12/20/2001	3	2		15.22	0.03	8.59	0.03	13.12	0.62	8.5	0.2	3.33
Higgins and Blek	113.649	37.295	Obsv1	Veyo	VY122001-2	12/20/2001	3	4		16.91	0.07	6.93	0.03	9.57	1.76	7.1	0.14	4.59
Higgins and Blek	113.640	37.312	Obsv1	Veyo	VY122001-3	12/20/2001	3	4		17.15	0.06	8.19	0.03	9.92	1.18	6.52	0.16	3.78
Higgins and Blek	113.640	37.309	Obsv1	Veyo	VY122001-4	12/20/2001	3	6		16.17	0.14	6.7	0.05	9.5	1.75	6.6	0.13	3.87
Higgins and Blek	113.645	37.328	Obsv1	Veyo	VY122001-5	12/20/2001	3	4		16.85	0.08	7.36	0.03	9.55	1.47	6.67	0.15	4.01
Higgins and Blek	113.651	37.336	Obsv1	Veyo	VY122001-6	12/20/2001	3	5		15.85	0.12	7.48	0.04	9.47	2.05	8.32	0.11	4.01
Higgins and Blek	113.646	37.342	Obsv1	Veyo	VY122001-7	12/20/2001	3	4		16.02	0.05	8	0.04	10.12	1.23	7.9	0.16	3.76
Higgins and Blek	113.659	37.343	Obsv1	Veyo	VY122001-8	12/20/2001	3	4		16.15	0.06	8.08	0.05	10.41	1.01	8.28	0.17	3.64
Higgins and Willis	113.693	37.310	Obsv4	Veyo	VY122001-9	12/20/2001	3	3		17.08	0.12	6.6	0.01	8.07	2.2	4.71	0.12	3.87
Higgins and Willis	113.666	37.324	Obsv1	Veyo	VY8301-1	8/3/2001	3	13		16.24	0.11	6.79	0.01	8.31	2.06	4.76	0.13	3.76
Higgins and Willis	113.693	37.333	Obsv1	Veyo	VY8301-2	8/3/2001	3	5		15.73	0.12	7.04	0.03	8.43	2.31	6.59	0.1	4.46
Higgins and Willis	113.670	37.348	Obsv1	Veyo	VY8301-3	8/3/2001	3	13		16.19	0.11	6.79	0.01	8.23	2.02	4.75	0.12	3.78
Higgins and Willis	113.672	37.350	Obsv1	Veyo	VY8301-4	8/3/2001	3	13		16.14	0.11	6.79	0.02	8.48	2.21	4.88	0.13	3.56
Higgins and Willis	113.676	37.347	Obsv1	Veyo	VY8301-5	8/3/2001	3	15		16.51	0.11	9.17	0.03	10.45	1.54	6.49	0.13	3.6
Higgins and Willis	113.662	37.372	Obsv1	Veyo	VY8301-6	8/3/2001	3	13		16.88	0.07	8.72	0.02	10.45	1.14	6.3	0.15	3.59
Higgins and Willis	113.666	37.367	Obsv1	Veyo	VY8301-7	8/3/2001	3	8		15.46	0.14	4.91	0.01	5.42	3.18	2.43	0.09	3.62
Higgins and Willis	113.678	37.363	Obsv1	Veyo	VY8301-8	8/3/2001	3	8		16.7	0.15	7.5	0.02	9.19	1.57	5.64	0.15	4.1
Higgins and Willis	113.668	37.323	Obsv1	Veyo	VY8301-9	8/3/2001	3	5		15.59	0.12	6.97	0.04	10.06	1.26	6.89	0.16	3.85
														8.35	2.3	6.42	0.1	4.42

Major oxide and trace element analyses of samples from basalt flows in the Veyo quadrangle.
Sample locations shown on geologic map.

P205	SiO2	SiO	TiO2	LOI	TOTAL	Ba	Ca	Cr	Cs	Co	Cu	Dy	Er	Eu	Gd	Ga	Hf	Ho	La	Pb	Lu
0.22	48.83	0.03	1.49	<0.01	99.76	226	30		<0.1	47.5	60	3.5	1.8	1	3.9	19	2	0.7	15.5	5	0.2
0.52	54.25	0.09	1.38	0.37	99.47	1275	115		0.5	26	60	5.2	2.7	2	6.8	21	6	1	59.5	25	0.4
0.86	50.06	0.11	1.47	<0.01	99.94	1095	148.5		0.1	30.5	40	4.8	2.9	2.3	7.6	20	5	1	77	15	0.4
0.51	53.63	0.09	1.44	0.05	99.4	1220	103		0.4	24.5	40	4.8	3.1	1.8	6	20	5	1	52.5	15	0.3
0.56	50.91	0.08	1.38	<0.01	99.96	1220	112.5		0.1	36.5	45	5.1	2.5	2.1	6.4	20	5	1	59	15	0.4
0.59	50.8	0.08	1.38	<0.01	99.81	1200	106		0.1	34	35	4.8	2.5	2.2	6.7	20	4	0.8	54.5	15	0.3
0.47	52.28	0.08	1.37	<0.01	99.75	1090	100.5		0.1	33	40	5.1	2.6	1.9	6.3	21	5	0.9	50	10	0.4
0.55	49.69	0.11	1.39	0.62	99.61	1255	114.5		0.2	32.5	50	4.4	2.4	2	6.4	21	4	0.9	56	10	0.3
0.71	51.45	0.14	1.53	<0.01	99.95	1330	138.5		0.1	33	35	5.4	2.6	2.5	7.8	18	6	1	62.5	10	0.4
0.63	47.7	0.13	1.59	0.04	99.47	1305	125.5		0.3	34.5	50	5.1	2.5	2.2	7.3	22	4	1	61	10	0.3
0.59	49.08	0.12	1.48	0.63	99.79	1245	119.5		0.2	33	40	4.8	2.4	2	7.1	21	4	0.9	59	10	0.3
0.63	47.97	0.13	1.57	0.11	99.04	1315	124		0.3	34.5	55	5.2	2.6	2.2	7.5	21	4	1	60	25	0.3
0.62	48.3	0.12	1.55	0.03	98.4	1255	121		0.1	33.5	45	4.7	2.3	2.2	6.9	21	4	0.9	59.5	15	0.3
0.6	48.24	0.12	1.53	0.11	99.57	1100	99.5		0.2	33.5	50	5.7	3.2	2	6.1	17	4	1	52.5	10	0.4
0.36	58.6	0.07	1.04	0.73	99.32	1435	113		0.6	18.5	20	4.4	2.3	1.7	6.3	20	6	0.8	57.5	20	0.3
0.49	51.84	0.09	1.35	1.28	99.51	1000	96		0.4	27	45	4.5	2.4	1.8	5.8	20	5	0.9	48.5	5	0.3
0.54	53.48	0.09	1.31	1.1	98.87	1190	106.5		0.5	23	35	4.7	2.5	1.7	6.3	19	5	0.9	55	15	0.4
0.52	54.58	0.09	1.29	0.47	99.45	1205	109		0.6	23	35	4.8	2.4	1.8	6.2	20	5	0.9	55.5	15	0.3
0.85	51.3	0.11	1.4	<0.01	99.64	1660	143		0.3	26.5	40	5.2	2.9	2.3	7.4	19	5	1	74	5	0.4
0.81	52.13	0.11	1.4	<0.01	99.89	1590	140.5		0.3	26	35	5.4	3	2.2	7.1	19	6	1	73	5	0.4
0.84	51.7	0.1	1.46	0.15	99.86	1540	129.5		0.4	24.5	30	5	2.6	2.3	6.7	18	5	1	66.5	10	0.4
0.53	54.85	0.09	1.29	0.13	99.49	1225	115.5		0.6	23.5	40	4.9	2.5	1.9	6.3	20	6	0.9	60	15	0.4
0.23	48.81	0.03	1.49	<0.01	99.62	234	30.5		<0.1	48.5	50	3.5	1.9	1.1	3.9	20	2	0.7	16	<5	0.3
0.62	50.54	0.09	1.58	<0.01	99.93	694	89		0.2	33	40	4.8	2.6	1.9	5.6	18	5	0.9	42.5	10	0.4
0.33	50.55	0.06	1.35	0.09	99.47	538	52		0.1	33	65	4.3	2.4	1.5	4.8	18	4	0.9	25.5	5	0.3
0.65	49.81	0.11	1.47	<0.01	99.95	1470	147		0.3	36.5	55	5.1	2.4	2.2	7.3	20	5	0.9	75.5	10	0.3
0.4	51.42	0.06	1.41	0.04	99.5	706	67		<0.1	36.5	50	5.1	2.9	1.7	5.7	20	5	1	32.5	5	0.4
0.78	49.1	0.13	1.62	0.15	99.23	1320	132		0.1	38.5	45	5.8	2.7	2.6	8.3	18	6	1.1	58.5	85	0.4
0.33	51.03	0.05	1.36	<0.01	99.75	497	54.5		0.2	43.5	60	4.1	2.4	1.4	4.7	19	4	0.9	26.5	20	0.3
0.52	50.06	0.05	1.37	0.33	99.96	583	54.5		<0.1	45.5	55	4.2	2.6	1.5	4.9	18	4	0.9	27	15	0.4
0.85	54.71	0.09	1.3	0.11	99.54	1305	125.5		0.7	26	40	5.2	2.9	2	6.9	22	6	1	64	15	0.4
0.4	55.82	0.07	1.26	<0.01	99.72	1060	92		0.5	26.5	45	4.3	2.3	1.7	5.7	20	5	0.9	45.5	15	0.3
0.66	52.49	0.13	1.44	0.03	99.56	1210	126.5		0.3	29	30	4.9	2.6	2.2	7.4	17	5	0.9	57	15	0.3
0.39	55.16	0.08	1.27	<0.01	98.88	1035	92		0.5	27	45	4.4	2.4	1.6	5.6	20	5	0.9	45.5	15	0.3
0.38	54.95	0.07	1.29	0.37	99.38	989	86		0.5	26	45	4.2	2.3	1.6	5.3	19	5	0.8	44	45	0.3
0.49	51.93	0.1	1.29	<0.01	99.86	1075	95.5		0.3	28.5	40	4	2.1	1.7	5.6	19	4	0.8	48.5	15	0.3
0.4	50.34	0.06	1.48	0.06	99.67	606	71		0.2	34	80	4.4	2.4	1.6	5.2	20	4	0.9	35	15	0.3
0.3	61.38	0.07	0.87	1.18	99.06	1345	101		1	12.5	20	3.8	2	1.4	5.1	19	5	0.7	51.5	35	0.3
0.78	52.25	0.1	1.34	<0.01	99.5	1560	136		0.4	26.5	45	5.1	2.9	2.2	7.1	19	5	1	69.5	15	0.4
0.84	49.87	0.11	1.4	0.1	99.59	1600	139.5		0.5	30.5	45	5	2.7	2.3	7	19	5	0.9	73	10	0.4
0.69	51.98	0.13	1.43	0.38	98.92	1175	123		0.2	29	30	4.9	2.6	2.2	7	17	5	0.9	55	15	0.3

Nd	Ni	Nb	Pr	Rb	Sm	Ag	Sc	Sr	Ta	Tb	Ti	Th	Tm	Sn	W	U	V	Yb	Y	Zn	Zr
135	135	9	3.5	7.2	3.2	<1		293	<0.5	0.6	<0.5	1	0.3	3	5	<0.5	155	1.7	19	100	92
44	44	26	12.1	36.4	7.3	<1		364	1	0.9	<0.5	7	0.4	5	2	1.5	145	2.4	27.5	85	236
65	43	35	15.7	16.4	9	<1		987	2	0.9	<0.5	13	0.4	4	2	2.5	150	2.7	29.5	95	230
30	30	24	10.9	28	6.7	<1		731	1	0.8	<0.5	6	0.3	7	3	1	150	2.4	25.5	85	218
44.5	125	32	12.1	17	7.5	<1		784	1.5	0.9	<0.5	9	0.4	4	3	1.5	165	2.5	28.5	90	228
46.5	45	27	12.6	17	8.1	<1		1050	1.5	0.7	<0.5	6	0.3	6	2	1.5	230	2.1	23.5	80	162
39.5	70	21	10.8	22	6.6	<1		730	1	0.8	<0.5	7	0.4	4	6	0.5	160	2.5	19.9	95	199
45.5	55	27	12.3	20.6	7.8	<1		1030	1	0.8	<0.5	5	0.4	4	3	1.5	205	1.9	24.5	95	180
60.5	110	22	15.8	26	9.7	<1		1200	1.5	0.9	<0.5	4	0.4	4	3	0.5	135	2.5	28.5	100	182.5
51.5	40	32	13.7	15.8	8.4	<1		1215	1.5	0.9	<0.5	4	0.4	4	3	0.5	135	2.5	28.5	100	249
49	49	40	13.4	19	7.9	<1		1105	1.5	0.9	<0.5	5	0.4	5	4	1.5	235	2.4	26.5	95	182
50.5	40	32	13.6	15.6	7.7	<1		1190	1.5	0.9	<0.5	5	0.4	3	3	1.5	220	2.1	25.5	90	176.5
40	40	31	13.2	14.4	8.3	<1		1155	1.5	0.9	<0.5	5	0.4	4	2	0.5	240	2.2	26.5	95	181
40	90	30	11.3	18.8	7	<1		708	2.5	0.8	<0.5	11	0.4	5	2	0.5	230	2.1	26	105	176
41.5	25	20	11.6	44	6.6	<1		675	0.5	0.8	<0.5	9	0.3	4	5	1.5	160	2.8	28.5	65	190
37.5	35	22	10.3	24.6	6.3	<1		738	0.5	0.8	<0.5	6	0.4	5	1.5	155	100	2.1	24.5	75	229
41.5	35	24	11.2	30.6	6.9	<1		705	1	0.8	<0.5	6	0.4	3	3	1.5	135	2.2	24.5	80	191
41.5	35	25	11.4	31.4	7.2	<1		720	1	0.9	<0.5	7	0.4	3	3	1.5	135	2.5	25.5	80	219
54	55	40	15.1	14.8	8.6	<1		937	2	0.9	<0.5	12	0.4	3	3	1.5	130	2.3	26	85	230
52.5	55	40	14.9	16.6	8.2	<1		847	2	1	<0.5	12	0.4	3	2	2	135	2.6	29	90	232
49.5	55	36	13.8	18	7.9	<1		816	2	0.9	<0.5	11	0.4	4	4	2	135	2.6	28.5	95	238
43	45	27	11.9	32	7.2	<1		719	1.5	0.8	<0.5	8	0.4	4	5	1.5	120	2.3	27	80	218
15.5	135	10	3.5	7.8	3.4	<1		304	<0.5	0.6	<0.5	1	0.3	4	2	<0.5	160	1.7	19.5	105	93.5
85	11	59	15	4.6	<1	<1		788	1.5	0.8	<0.5	3	0.3	2	2	<0.5	125	2.4	26	80	251
22.5	115	40	15.8	26.6	8.8	<1		454	<0.5	0.7	<0.5	1	0.4	3	2	<0.5	140	2.4	24.5	85	167.5
30	115	17	7.6	15.2	5.7	<1		581	0.5	0.8	<0.5	3	0.4	4	3	1.5	185	2.1	25.5	90	201
58	135	24	15.5	22.2	9.8	<1		1235	1.5	1	<0.5	3	0.4	5	3	<0.5	135	2.6	28	85	201
23.5	160	11	6.1	16.8	4.7	<1		515	<0.5	0.7	<0.5	3	0.3	4	3	0.5	145	2.7	30	80	273
40	170	10	6.3	8	4.7	<1		514	<0.5	0.7	<0.5	3	0.4	4	3	0.5	155	2.3	24.5	85	165
37	50	30	13	34	8.1	<1		789	1.5	0.9	<0.5	6	0.3	4	1	0.5	150	2.1	24.5	95	159
47	50	30	10	36.2	6.6	<1		622	1	0.8	<0.5	8	0.4	3	3	1.5	135	2.7	29	90	266
37	50	20	10	24.6	8.7	<1		1045	1	0.9	<0.5	4	0.4	3	2	1	135	2.1	26	80	184
53	95	20	14.3	36.2	6.2	<1		611	1	0.7	<0.5	6	0.3	3	2	1	135	2.2	28	70	229
36	50	20	9.8	36.2	5.6	<1		567	0.5	0.8	<0.5	6	0.3	3	2	1	130	2.1	23.5	75	182
34	50	20	9.3	33.8	6.1	<1		827	0.5	0.7	<0.5	5	0.3	3	2	1	180	2	21	80	182.5
37.5	50	23	10.3	22.6	5.3	<1		533	0.5	0.7	<0.5	4	0.4	3	3	0.5	165	2.3	25	85	157
18.5	60	17	7.8	18.2	6	<1		537	0.5	0.7	<0.5	8	0.3	3	3	1.5	75	1.8	20.5	100	209
37	35	17	10.4	55.6	8.1	<1		844	2	0.9	<0.5	11	0.4	3	2	2	135	2.5	27.5	95	235
51	60	38	14.4	20.2	8.1	<1		937	2	0.9	<0.5	12	0.4	3	2	2	120	2.3	27	105	203
53	65	40	14.6	15	8.2	<1		1035	1	0.9	<0.5	4	0.3	3	2	0.5	150	2.2	25	70	233
52.5	90	20	13.9	25.2	8.3	<1															

